

SECTION 542.00 – PREVENTIVE MAINTENANCE

Preventive maintenance is a planned strategy of cost-effective surface treatments applied to an existing roadway to preserve the roadway system, retard future deterioration, and maintain or improve the functional condition of the system. The preventive treatments of existing pavements increase pavement longevity by reducing damage from sun and water and a safer road surface for the user, but these treatments cannot solve fatigue-related pavement distress or problems within the base, subbase, or subgrade layers. Only structurally designed rehabilitation or reconstruction alternatives will mitigate fatigue-related distress and/or inadequate pavement structural capacity.

542.01 Preventive Maintenance Design Considerations. The various maintenance alternatives described in the following sections will guide the designer to select and design appropriate preventive maintenance surface treatment and understand the general conditions under which these treatments work. To assure success for surface treatments, the designer must consider:

- Whether the selected pavements can actually be improved by a surface treatment. (Preventive maintenance needs to be done early in the pavement's life cycle before distress begins to affect pavement integrity. Cracks must be sealed while they are narrow, ruts are shallow, etc.)
- Proposed preventive maintenance in relation to the next road surface reconstruction activity.
- The life cycle of durable pavement markings.
- Product consistency in the specification and use from project to project within the District. (Each change of product, i.e., a change in type of asphalt, can require re-calibration and re-establishment of what works the best -- possible problems.)
- Straightforward, simple contracts that are easily understood, administered, and executed.

Each District should assign an individual, who is well versed in surface treatments, to administer and inspect the District's preventive maintenance projects. The physical properties of the materials to be worked and engineering judgment control each situation. Preventive maintenance projects move rapidly and have little or no margin for indecision. Failure of a surface treatment creates public outcry, is difficult to clean up, and wastes dollars.

542.02 Additional Information. For additional information, contact headquarters Maintenance or Materials section. Additional information can also be found in Pavement Maintenance Effectiveness Preventive Maintenance Treatments, FHWA-SA-96-027.

542.03 Preventive Maintenance Techniques. The following tables list ([Tables 542.03-1](#) and [542.03-2](#)) techniques and offers guidance in selection of the appropriate technique to address various problems. Subsections [542.03.01](#) through [542.03.15](#) detail maintenance techniques for asphalt (flexible) pavement. Subsections [542.03.16](#) through [542.03.19](#) cover preventive maintenance techniques for concrete (rigid) pavement.

Methods other than those shown in the table exist and may be suited to particular projects depending on the specific application.

**TABLE 542.03-1 PREVENTIVE MAINTENANCE TECHNIQUES –
ASPHALT PAVEMENT SURFACES**

Preventive Maintenance Technique	Reason for Use						Traffic Volume		Average Life	Average Cost
	Friction	Raveling	Rutting	Seal Minor Cracks	Aging & Oxidation	Keep Out Water	Low	High	(years)	Per lane-mile
542.03.01 Crack Sealing						X	X	X	1-4	2,000-4,000
542.03.02 Fog Seal & Rejuvenators		X		X	X	X	X		1-2	1,400-1,700
542.03.03 Slurry Seal	X	X		X	X	X	X		2-5	5,000-8,000
542.03.04 Micro-surfacing	X	X	X		X	X	X	X	5-8	18,000-24,000
542.03.05 Sand Seal		X		X	X	X			2-5	8,000-13,000
542.03.06 Chip Seal	X	X		X	X	X	X		5-8	7,000-10,000
542.03.07 Quick Setting Chip Seal	X	X		X	X	X	X		5-8	7,000-10,000
542.03.08 Cape Seal	X	X		X	X	X	X	X	6-10	8,000-13,000
542.03.09 Double Chip Seal	X	X		X	X	X	X		8-14	8,000-13,000
542.03.10 Plant Mix Seal (SSP-412)	X			X	X	X	X	X	5-8	10,000-16,000
542.03.11 Thin Hot Mix Overlay	X	X	X	X	X	X	X	X	7-10	11,000-18,000
542.03.12 Stone Matrix Asphalt	X	X	X	X	X	X	X	X	7-10	13,000-19,000
542.03.13 Cold-in-Place Recycling	X	X	X	X	X	X			5-10	11,000-18,000
542.03.14 Hot-in-Place Recycling	X		X	X	X	X	X	X	7-10	14,000-19,000
542.03.15 Clean Drainage System						X	X	X	n/a	n/a

**TABLE 542.03-2. PREVENTIVE MAINTENANCE TECHNIQUES –
CONCRETE PAVEMENT SURFACES**

Preventive Maintenance Technique	Reason for Use						Traffic Volume		Average Life	Average Cost
	Friction	Raveling	Rutting	Seal Minor Cracks	Aging & Oxidation	Keep Out Water	Low	High	(years)	Per lane-mile
542.03.16 Crack Joint Sealing				X		X		X	1-5	35,000-70,000
542.03.17 Subsealing					X			X	10	32,000-64,000
542.03.18 Retrofit of Dowel Bars			X			X		X	10	50,000-87,000
542.03.19 Grinding Concrete Pavement	X		X		X	X		X	10	16,000-27,000

542.03.01 Crack Sealing.

Description	A flexible sealant that is applied to cracked plant mix pavement.
Purpose	Adds waterproofing to the surface and keeps out incompressible material.
Treatment Timing	Can be done any time cracks develop in the surface, usually one to two (1-2) years on overlays and four to five (4-5) years on new construction. Crack sealing should be accomplished on a continual basis and before cracks exceed 1/8 - 1/4 inch.
Existing Pavement Condition	Should be in good condition with very little secondary cracking.
Surface Preparation	Surface and cracks should be dry. Route, clean, and dry all cracks, and use backer rods if appropriate.
Construction Limitations	Need cool and dry weather to ensure maximum crack width. Do not overfill the crack as will cause surface roughness in warmer weather. A light application of clean blotter (reduces dust and penetration into the crack) immediately following the sealant application can help reduce bleeding and keep seal from being damaged by traffic.
Existing/Projected Traffic	Use on all roads.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize danger to the work crew. Restriction time generally depends on ambient conditions and the number of cracks to seal prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	Generally one to four (1-4) years depending on type and severity of cracks, amount of traffic, and the geometry of the road. Heavy commercial traffic and frequent stopping and turning movements reduce the life and cause localized deterioration.

542.03.02 Fog Seal and Rejuvenators.

Description	A sealant or chemical that is applied to oxidized plant mix pavement surface.
Purpose	Provides water proofing surface membrane to enrich the asphalt content of the surface and reduce the rate of surface oxidation and raveling.
Treatment Timing	Can be applied as temporary water proofing membrane and rejuvenators can be applied during warm weather once oxidation and raveling are imminent.
Existing Pavement Condition	New plant mix placed late in the construction season, open surfaces due to roller cracking, aggregate segregation, surface smoothness, grinding, or raveling.
Surface Preparation	Dry and clean the surface with a power broom.
Construction Limitations	Best applied during warm or hot, dry weather. Perform a permeability test prior to applying a fog seal to new pavement.
Existing/Projected Traffic	Best on lower volume roads, but can be used on all roads when needed.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize danger to the work crew. Restriction time generally depends on ambient conditions prior to reopening to unrestricted traffic. Blotter may be required under certain conditions.
Anticipated Performance/Service Life	Depends on the type of seal applied. May be one to two years for sealants, depending on type and severity of oxidation or raveling, permeability, amount of traffic, and the geometry of the road. Rejuvenators may add three to seven years to the life of a pavement if applied at the proper point in the pavement service life.

542.03.03 Slurry Seal.

Description	A mixture of asphalt emulsion, well graded fine aggregate, mineral filler, and water. A slurry machine mixes the materials (slurry) and the mixture is then applied to the pavement surface.
Purpose	Seals an existing pavement and produces some minor leveling without the inconvenience of loose gravel. Can also be used for mass crack filling, to improve skid resistance, to enhance appearance, to reduce studded tire wear, slow the rate of oxidation and weathering, and retard raveling by renewing the surface. Slurry made with coal tar emulsion can protect the pavement in parking areas from petroleum drips/spills.
Treatment Timing	As minor surface cracking first develops, or to treat light to moderate raveling and/or oxidation.
Existing Pavement Condition	Should have a good sound base and minimal transverse or longitudinal cracks. Larger cracks should be addressed before application. The pavement can have some minor rutting. If ruts are over 1/2 inch, the ruts should be filled prior to full width lane application.
Surface Preparation	Immediately prior to application of the slurry seal, clean the existing surface with a power broom of all loose material, oil spots, vegetation, and other objectionable material. If water is used, cracks must be thoroughly dried. If the surface is very dry or moderately raveled, apply a tack coat. In hot weather, pre-wet the surface to control premature breaking of the emulsion. Manholes, valve boxes, drop inlets, and other service entrances must be protected by a suitable method.
Construction Limitations	SHALL NOT be applied if either the pavement or air temperature is below 50°F and falling, but may be applied when both pavement and air temperature are above 45°F and rising. DO NOT apply when there is danger that the finished product will freeze during the next twenty-four (24) hours. DO NOT apply when weather conditions prolong opening traffic beyond a reasonable time. Static rolling to force water expelled from the emulsion to the surface may be advantageous.
Existing/Projected Traffic	Use on low volume city streets, county roads, and shoulders of high volume roadways.
Traffic Control/Release	Reroute traffic until slurry sets; about two (2) hours in warm weather and up to six to twelve (6-12) hours in cold weather. Additives can be added to slurry mixture to accelerate the set time
Anticipated Performance/Service Life	On roads with moderate to heavy traffic, nominal life is two to five (2-5) years.

542.03.04 Microsurfacing.

Description	A thin surface cold-mix paving system composed of polymer-modified asphalt emulsion, 100% crushed aggregate, mineral filler, water, and additives. A self-propelled, continuous-loading slurry machine is used to proportion and mix the materials and apply the mixture to the pavement surface.
Purpose	A thin, restorative surface on urban arterials and heavy traffic intersections. Does not alter drainage --no loss of curb reveal. In quick-traffic applications as thin as 3/8 inch, can improve skid resistance, add service life to high-speed roadways (interstates), fill ruts, retard raveling and oxidation, correct surface irregularities, and increase color contrast. May often be reopened to traffic within an hour.
Treatment Timing	Best when non-plastic ruts do not exceed 5/8 inch or friction drops to unacceptable levels. May be used when oxidation becomes moderate to severe on pavements with minor cracking.
Existing Pavement Condition	A stable pavement with minimal cracking. Visible surface distresses may include minor cracking, non-plastic rutting, polished surface, moderate raveling, and moderate to severe oxidation. Little to no patching is required, however cracks should be sealed prior to work.
Surface Preparation	Thoroughly clean the surface immediately prior to application. Place a tack coat on heavily oxidized or excessively dry plantmix pavement surfaces and concrete pavement surfaces. Pre-wet the pavement in hot weather to reduce pavement temperature to control premature breaking of the emulsion and to improve bonding with the existing surface.
Construction Limitations	Avoid late season application. Do not use on pavements with moderate to heavy cracking. Poor crack sealer due to brittle nature.
Existing/Projected Traffic	No limits on traffic volumes or traffic classification.
Traffic Control/Release	Reroute traffic until the Microsurfacing cures and develops strength (which occurs much faster than conventional slurry seals). Roads can be reopened to rolling traffic in about one (1) hour.
Anticipated Performance/Service Life	Provides a reasonably long-term solution for friction improvement, rut filling, and reduction of surface oxidation and weathering when applied on stable pavements. Expected service life is five to eight (5-8) years.

542.03.05 Sand Seal.

Description	A sprayed application of asphalt that is immediately followed by a thin layer of sand aggregate.
Purpose	Used on pavements that have lost some of their matrix. Is desirable for tightening the pavement texture and reducing raveling.
Treatment Timing	Can be done anytime following plant mix placement, but should not be performed until actually warranted, i.e., loss of friction, oxidation, excessive permeability, etc. Recommend waiting three to four (3-4) years after paving before sealing. Seals over new road mix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.
Surface Preparation	Clean with power broom to remove all loose debris.
Construction Limitations	Surface temperatures between 80° F and 140° F are recommended. Require a period of warm weather and relatively low humidity following the treatment for proper breaking or curing of the asphalt.
Existing/Projected Traffic	Use on low volume, low speed pavements, parking areas, and bike/pedestrian paths.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize the damage to the newly treated surface. The length of time depends on ambient conditions.
Anticipated Performance/Service Life	Generally two to five (2-5) years, depending on type and amount of traffic and the geometry of the surface. Heavy commercial traffic and frequent stopping and turning movements reduce the life and cause localized deterioration.

542.03.06 Chip Seal.

Description	A sprayed application of asphalt, typically an emulsion or cutback, immediately covered by one or more layers of aggregate.
Purpose	Adds waterproofing to the surfaces, improves surface friction, seals small to medium sized cracks, and retards mix binder stripping and oxidation.
Treatment Timing	Can be done anytime following plant mix placement, but should not be performed until actually warranted, i.e., loss of friction, oxidation, excessive permeability, etc. Recommend waiting three to four (3-4) years after paving before sealing. Seals over new road mix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	A stable pavement on a sound base with a good cross section and good lateral support. Visible surface distresses may include raveling, surface wear, longitudinal cracks and transverse thermal cracks with some secondary cracking, and some deterioration along crack faces. A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.
Surface Preparation	The surface should be dry, especially when using cutbacks. Cracks over 1/8-1/4 inches should be sealed. Excessively flushed pavements require milling to prevent future flushing problems.
Construction Limitations	<p>Recommend surface temperatures between 80° F and 140° F and requires warm weather and relatively low humidity following the treatment for proper breaking or curing of the asphalt and embedment of the chips.</p> <p>A light application of clean blotter immediately following the application can reduce bleeding and keep chips from being removed by traffic.</p> <p>A fog coat can provide better chip retention if applied chips are not embedded to at least 30% of the largest chip size.</p>
Existing/Projected Traffic	Use on predominantly low to medium volume roads (ADT <1000- 5000/lane) or roads with low speeds.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize the loss of chips from the pavement surface. The length of time generally depends on ambient conditions. Broom the surface to remove loose chips prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	Generally five to eight (5-8) years, depending on type and amount of traffic and the geometry of the road. Heavy commercial traffic and frequent stopping and turning movements reduce the life and cause localized deterioration.

542.03.07 Quick Setting Chip Seal.

Description	A sprayed application of nonpolymerized, paving grade asphalt immediately covered by one or more layers of hot, precoated aggregate.
Purpose	Adds waterproofing to the surfaces, improves surface friction, seals small to medium sized cracks, and retards mix binder stripping and oxidation. Produces minimal loose rock and traffic can be released in a short time.
Treatment Timing	Can be done anytime following plant mix placement, but should not be performed until actually warranted, i.e., loss of friction, oxidation, excessive permeability, etc. Recommend waiting three to four (3-4) years after paving before sealing. Seals over new road mix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	A stable pavement on a sound base with a good cross section and good lateral support. Visible surface distresses may include raveling, surface wear, longitudinal cracks and transverse thermal cracks with some secondary cracking, and some deterioration along crack faces. A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.
Surface Preparation	The surface should be dry, especially when using cutbacks. Can address light cracking, but cracks wider than 1/8-1/4 inch should be sealed. Excessively flushed pavements require milling prior to sealing to prevent future flushing problems.
Construction Limitations	<p>Projects must be located relatively close to hot mix facilities for the precoated aggregate. Cover coat material should be placed at a minimum temperature of 225° F.</p> <p>The chip spreader must follow closely behind the sprayed asphalt because the asphalt is a paving grade and there is no “curing” time. The seal is set as the asphalt cools.</p> <p>Polymerized asphalts SHOULD NOT be used (sticks to rubber tires if not completely cooled).</p>
Existing/Projected Traffic	Designed for use on higher volume roadways or areas that cannot tolerate lengthy traffic disruptions.
Traffic Control/Release	Shorter delays than standard chip seals. Restrict traffic and reduce speeds to minimize the loss of chips from the pavement surface. The length of time generally depends on ambient conditions. Broom the surface to remove loose chips prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	Generally five to eight (5-8) years, depending on type and amount of traffic and the geometry of the road. Heavy commercial traffic, frequent stopping, and turning movements reduce the life and cause localized deterioration.

542.03.08 Cape Seal.

Description	A two-layer maintenance technique consisting of a chip seal followed by a slurry seal.
Purpose	Produces a seal with no loose cover stone and adds minor structure. The maximum size of chip used for the seal establishes the depth of the mat.
Treatment Timing	Can be done anytime following plant mix placement, but should not be performed until actually warranted, i.e., loss of friction, oxidation, excessive permeability, etc. Recommend waiting three to four (3-4) years after paving before sealing. Seals over new road mix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	A stable pavement on a sound base with a good cross section and good lateral support. Visible surface distresses may include raveling, surface wear, longitudinal cracks and transverse thermal cracks with some secondary cracking, and some deterioration along crack faces. A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.
Surface Preparation	The surface should be dry, especially when using cutbacks. Can address light to moderate cracking, but cracks wider than 1/8 - 1/4 inch should be sealed. Excessively flushed pavements require milling prior to sealing to prevent future flushing problems.
Construction Limitations	Limitations of each treatment (chip seal/slurry seal) apply. Requires approximately four to ten (4-10) days curing period between the chip seal and slurry seal. Remove loose chips prior to the slurry seal.
Existing/Projected Traffic	May be best suited to higher volume roadways.
Traffic Control/Release	Traffic is disrupted on two different occasions. Restrict traffic and reduce speeds to minimize the loss of chips from the pavement surface. The length of time generally depends on ambient conditions. Broom the surface to remove loose chips prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	Six to ten (6-10) years, depending on type and amount of traffic and the geometry of the road. Heavy commercial traffic, frequent stopping, and turning movements reduce the life and cause localized deterioration.

542.03.09 Double Chip Seal.

Description	A two-layer chip seal application.
Purpose	Waterproofs the surfaces, improves surface friction, seals small to medium sized cracks, and retards mix binder stripping and oxidation.
Treatment Timing	Can be done anytime following plant mix placement, but should not be performed until actually warranted, i.e., loss of friction, oxidation, excessive permeability, etc. Recommend waiting three to four (3-4) years after paving before sealing. Seals over new road mix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	A stable pavement on a sound base with a good cross section and good lateral support. Visible surface distresses may include raveling, surface wear, longitudinal cracks and transverse thermal cracks with some secondary cracking, and some deterioration along crack faces. A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of slight to moderate block cracking, moderate to severe oxidation, and/or slight to moderate flushing or polishing.
Surface Preparation	The surface should be dry, especially when using cutbacks. Can address light to moderate cracking, but cracks larger than 1/8 - 1/4 inch should be sealed. Excessively flushed pavements require milling prior to sealing to prevent future flushing problems.
Construction Limitations	Recommend surface temperatures between 80° F and 140° F, followed by a period of warm weather and relatively low humidity for proper breaking or curing of the asphalt and embedment of the chips. A light application of clean, dust free blotter immediately following the chip application can help reduce bleeding and keep chips from being removed by traffic.
Existing/Projected Traffic	Designed for use on higher volume roadways or areas that cannot tolerate lengthy traffic disruptions.
Traffic Control/Release	Second application increases traffic disruption.
Anticipated Performance/Service Life	Can double the life of a single chip seal - generally eight to fourteen (8-14) years. Gives increased service life over a single chip seal while adding minor structure at approximately 1½ times the cost of a single chip seal.

542.03.10 Plant Mix Seal (PMS).

Description	A thin overlay of plant mix pavement, typically $\frac{3}{4}$ to $1\frac{1}{2}$ inches thick. SSP 412 Plant Mix Seal is used as the specification document.
Purpose	<p>Waterproofs the surfaces, improves surface friction, seals small to medium sized cracks, and retards mix binder stripping and oxidation. Use as an alternative to chip seals in urban areas. Can choose:</p> <p>PMS-OG - open graded mix with approximately twenty percent (20%) air voids to allow water to pass through, leaving the surface "dry." The underlying pavement should be in very good condition and have a tight or sealed surface.</p> <p>PMS-MG - medium graded mix commonly specified in Idaho. Seals the underlying pavement and provides a good friction course.</p> <p>PMS-DG - dense graded mix similar to a thin hot mix overlay. May be counted as part of the ballast section. Seals the underlying pavement and provides a good friction course.</p>
Treatment Timing	Can be done anytime following plant mix placement. Generally used when needed. Seals over new roadmix pavements should not be done for at least two (2) weeks for volatiles to evaporate.
Existing Pavement Condition	Any existing defects in the pavement will come through. Visible surface distresses may include raveling, surface wear, rutting, longitudinal cracks and transverse thermal cracks with some secondary cracking, and some deterioration along crack faces. A minor amount of patching in good condition is acceptable, provided a good cross section has been maintained. The surface may show signs of moderate to severe oxidation, and/or slight to moderate flushing or polishing. If the surface shows signs of block cracking or alligator cracking the section should be cut out and patched with full depth plant mix pavement. Base failures should be repaired prior to patching.
Surface Preparation	Cracks quickly come through. Cracks wider than $\frac{1}{8}$ - $\frac{1}{4}$ inch should be sealed and the crack filler allowed to cure. Repair distressed areas.
Construction Limitations	Thin lifts lose heat quickly. Do not consider PMS a structural element or able to solve structural deficiencies. Thickness of PMS requires cold milling off at the end of service life, particularly in urban areas where gutter elevations must be maintained.
Existing/Projected Traffic	Use on high speed, high volume roads (ADT > 6,000 /lane) and in urban areas where dust or flying chips and high traffic volumes cannot be tolerated.
Traffic Control/Release	Pilot or divert traffic around the paving operation and keep off until the PMS is rolled and cooled enough to allow traffic again.
Anticipated Performance/Service Life	Generally five to eight (5-8) years, depending on type and amount of traffic and the geometry of the road. PMS-OG (open graded) has a tendency to plug with sanding material and may not perform well in areas where heavy sanding is common.

542.03.11 Thin Hot Mix Overlay.

Description	A dense graded hot mix overlay limited to 1½ inch thickness as an overlay or an overlay of a previously milled surface (inlay).
Purpose	The highest type of alternatives available in the preventive maintenance program. Thin overlays protect and enhance the pavement structure, reduce the rate of pavement deterioration, correct surface deficiencies, reduce permeability, and improve the ride quality of the pavement, particularly when accompanied by surface milling.
Treatment Timing	Generally later in a pavement's service life, but always prior to the onset of fatigue-related pavement distress.
Existing Pavement Condition	A stable pavement on a sound base with a fair cross section and good lateral support. Visible surface distresses may include moderate to extreme raveling, surface wear, longitudinal cracks and transverse thermal cracks with some secondary cracking and deterioration along crack face. A moderate amount patching in good condition is acceptable, provided the repair is confined to the surface course and a good cross section has been maintained. Surface may show signs of moderate to severe block cracking, moderate to severe oxidation, and/or moderate to severe flushing or polishing. Milling prior to overlay is recommended when severe surface distress is encountered.
Surface Preparation	<p>(Milling) Remove the entire existing surface course approximately 1/4 inch into the intermediate layer. Correct the longitudinal and transverse profiles according to contract specifications. Pavement surface should be cleaned, dry, and tacked prior to the overlay.</p> <p>(No Milling) Seal any cracks wider than 1/8 - 1/4 inch. Repair minor base instabilities and depressions, fill voids in the pavement surface, and/or provide plant mix leveling course. Remove patched areas with high asphalt contents and replace with new material to prevent bleeding through the new plant mix surface. Pavement surface should be dry, cleaned and tacked prior to the overlay.</p>
Construction Limitations	(Seasonal) All requirements of Section 405 Plant Mix Pavement apply. Consider reduction in skid resistance. DO NOT use on pavements exhibiting structural distress or deterioration. Due to the lift thickness, recommend maximum nominal plant mix aggregate.
Existing/Projected Traffic	Applicable for all traffic levels and loadings when pavement structure is properly designed.
Traffic Control/Release	All requirements of Section 405 Plant Mix Pavement apply.
Anticipated Performance/Service Life	Anticipated life is seven to ten (7-10) years for moderate to heavy traffic provided adequate pavement structure exists. The condition of the existing pavement, the adequacy of the mix design and the quality of the overlay construction all affect the extension in service life.

542.03.12 Stone Matrix Asphalt.

Description	A dense graded plant mix with a high percentage of coarse aggregate to provide a stone-on-stone "skeleton". Stone Matrix Asphalt should be considered an experimental alternative.
Purpose	Resists rutting/shoving from the mechanical interlock of coarse particles
Treatment Timing	Generally later in a pavement's service life than for other alternatives, but prior to the onset of fatigue-related pavement distress.
Existing Pavement Condition	Light to moderate lateral rutting and shoving in wheelpaths or corrugations and shoving in stopping, accelerating, or turning locations.
Surface Preparation	Existing pavements should be milled at least to a depth to allow a minimum thickness of stone matrix plant mix (typically 3 to 5 times the nominal maximum aggregate size).
Construction Limitations	<p>Cannot be feathered due to the large percentage of coarse aggregate. Functions best in a patching application and should be confined to be effective.</p> <p>Seal shortly after placement because of the coarse, open texture of the surface.</p>
Existing/Projected Traffic	Designed for high volume roads or low speed locations with high turning movements.
Traffic Control/Release	All requirements of Section 405 Plant Mix Pavement apply.
Anticipated Performance/Service Life	Similar to conventional plant mix - seven to ten (7-10) years for moderate to heavy traffic provided adequate pavement structure exists. Rutting should be significantly reduced/retarded.

542.03.13 Cold-in-Place Recycling (CIR).

Description	A pavement recycling application. Uses a milling machine, a hammermill crusher, and a pugmill mixer without the application of heat to pulverize a portion of an existing bituminous pavement, then mix a small amount of emulsified asphalt (as a binder rejuvenator) and cement or lime slurry (as a mineral filler and for stabilization), and place a base for a subsequent overlay of chip seal or hot mix overlay.
Purpose	Reworks the upper layers of the pavement structure to improve stability, resist moisture intrusion, and correct a variety of distresses in the upper pavement layers, including light fatigue-related distress.
Treatment Timing	Limited to pavements in relatively good structural condition that has a stable and adequate base.
Existing Pavement Condition	Light alligator cracking and rutting - if confined to the surface or upper layers, and all environmentally related surface distresses. Distresses from subgrade or base failures cannot be effectively remedied.
Surface Preparation	The pavement surface should be dry and cleaned immediately prior to recycling the existing pavement.
Construction Limitations	<p>May 1 - September 30 if overlaid; June 15 - September 1 if seal coated. A detailed mix design is suggested to determine the type/grade of recycling agent to be used. Projects characterized by shady areas are not recommended. Plant mix overlay is recommended; double chip seal or other sealcoat measures may be considered as a wearing course; however, justification is required.</p> <p>Excessive moisture in the cold recycled material critically impacts performance. The recycled surface cannot adequately resist moisture intrusion or traffic abrasion on its own.</p> <p>Depth is limited to within 1 to 1 3/8 inch of the base layer to preclude tearing of the pavement base and deficiencies in the CIR layer. The depth can extend through the entire depth of pavement to approximately 6 inches (greater than 6 inches requires justification). If less than the total pavement depth is recycled, the recycle depth must penetrate the plane of previous paving courses to avoid slip planes.</p>
Existing/Projected Traffic	Usually low volume roads; not recommended for roads characterized by high volumes of truck traffic (additional maintenance during the curing period would be needed).
Traffic Control/Release	Requires a curing period of seven to fourteen (7-14) days to dry the material to a moisture content of 1 to 1 ½ percent. Keep traffic off the recycled pavement for about two (2) hours after compaction.
Anticipated Performance/Service Life	Service life of five to ten (5-10) years. Proper binder content and distribution of the binder in the recycled mixture is critical for satisfactory performance.
Precaution	A CIR application of 1.5% lime slurry/1.5% CMS-2S emulsified asphalt has had medium success as a general application.

542.03.14 Hot-in-Place Recycling (HIR).

Description	An asphalt pavement recycling technique, which consists of softening the surface with heat, mechanically removing the surface material, mixing the recycled material, and replacing and recompacting the material on the roadway. Three HIR techniques in common use are: 1) Heater scarification process where the old pavement is heated, scarified, mixed with a recycling agent, leveled and recompacted. Scarification depths range from 3/4 to 2 inches. 2) Repaving process where the newly constructed hot layer is placed as a leveling course followed with a plant mix surface course to form a thermal bond between the new and recycled layers. 3) Remixing process where the surface of the existing pavement is scarified and mixed with controlled amounts of virgin mix and/or rejuvenating agents in an on-board pugmill, then the resultant mixture is placed as a single homogenous course and seal coated to prevent raveling and keep out moisture.
Purpose	Address surface pavement distress, including rutting, corrugations, raveling, flushing, loss of surface friction, and minor thermal cracking; improve pavement cross slope and surface drainage; and/or correct gradation and/or asphalt content problems.
Treatment Timing	Limited to pavements in relatively good structural condition that has a stable and adequate base.
Existing Pavement Condition	Good structural condition and at least 1/4 inch thick. Requires substantial testing to confirm consistency of existing plantmix pavement for mix design development.
Surface Preparation	Dry pavement surface – damp/wet surface requires increased heating to remove the surface layer, slows the speed of the operation, and increases the Contractor's energy costs. Clean the pavement surface and remove all raised pavement markers.
Construction Limitations	<p>Limited to pavements in relatively good structural condition with a stable and adequate base. Only the top one to two (1-2) inches of the pavement are reconditioned and only modest additions to the pavement structure result. Cracks will return very quickly. Interstate usage may have shorter service life.</p> <p>Requires extra steps and can have greater variability within a project and between projects.</p> <p>Best performed in warm to hot weather, April 1-September 30. If a seal coat is specified, must be completed by August 31.</p>
Existing/Projected Traffic	Use on higher volume routes.
Traffic Control/Release	Cool the pavement surface below 150° F prior to releasing traffic.
Anticipated Performance/Service Life	Performance should be seven to ten (7-10) years. The surface course used in conjunction with HIR influences the service life.
Precaution	Existing pavement materials must be identified so the type and amount of the recycling agent can be determined and the need for virgin aggregate ascertained. Seal coats add extra asphalt to the mixture and may require to be milled off prior to recycling. Most HIR projects use an asphalt emulsion or an emulsified recycling agent as an additive to the recycled mix. The recycle depth must be designed to penetrate the plane of previous paving courses to avoid creation of slip planes.

542.03.15 Clean Drainage System. (Asphalt or Concrete Pavements).

Description	Activity preserves the functionality of the pavement structural drainage features of existing asphalt and concrete pavements and consists of cleaning soil, debris and vegetation at underdrain outlets, inspection of edge drain pipes and flushing underdrain systems as needed.
Purpose	Preserve the drainage system that removes water from the pavement structure.
Treatment Timing	Periodic maintenance of drainage outlets and systems is critical to achieve optimum pavement performance, particularly on sections constructed with permeable bases. Perform at least once a year and more often if needed. The work can be done at any time of the year. Use a pipe camera to determine the functionality of edge drain pipes and underdrain systems.
Existing Pavement Condition	N/A
Surface Preparation	N/A
Construction Limitations	<p>No seasonal limits.</p> <p>A Corps of Engineers Section 404 Permit may be required.</p> <p>Evaluate the condition of the existing drainage system prior to using high-pressure water jets to remove debris.</p>
Existing/Projected Traffic	N/A
Traffic Control/Release	N/A
Anticipated Performance/Service Life	Preservation of the drainage system extends the service life of asphalt pavements.

542.03.16 Crack and Joint Sealing (Concrete Pavements).

Description	Application of a sealant (thermoplastic materials, thermosetting materials, or preformed compression seals) to concrete pavement cracks and joints that are open enough to permit the entry of joint sealant or mechanical routing tools. Refer to SSP's 423, 425, and 428.
Purpose	Inhibit the intrusion of surface water/keep out incompressible material.
Treatment Timing	Excessive delay in replacing a failing sealant system can result in rapid deterioration of the concrete pavement. Reseal joints and cracks when twenty-five to fifty percent (25-50%) of the existing sealant material has failed or moisture and/or incompressible materials are past the sealant to underlying layers.
Existing Pavement Condition	Good condition with very little secondary cracking or spalling.
Surface Preparation	<p>Surface and crack must be dry. Remove the old sealant and clean the crack (compressed air, heat lance, or sandblasting) completely free of dirt, dust, and other materials that might prevent bonding of the sealant.</p> <p>The depth should be approximately twice the width of the crack. For open cracks, make a groove about 3/8 inch wide and 3/4 inch deep along the crack using a diamond blade; random cut saws, random crack grinders, or vertical bit routers, whichever is capable of closely following the path of the crack and widening the top without causing excessive spalling or other damage to the concrete.</p>
Construction Limitations	<p>For bituminous sealants, cool, dry weather is required to ensure maximum crack width and dry conditions. Do not overfill the crack, which causes surface roughness in warmer weather. Apply clean, dust free blotter immediately following the sealant application to reduce bleeding and damage by traffic.</p> <p>May not be effective if the existing pavement is badly deteriorated. Routing could actually contribute to further spalling by stressing the weakened surface.</p>
Existing/Projected Traffic	Use on all concrete pavements.
Traffic Control/Release	<p>Restrict traffic and reduce speeds to minimize danger to the work crew. The length of time depends on ambient conditions and the number of cracks to seal prior to reopening to unrestricted traffic. See manufacturer recommendations regarding release time for traffic.</p>
Anticipated Performance/Service Life	Depending on the product used, joints may be temporarily sealed for one to two (1-2) years until the pavement is rehabilitated or replaced, sealed and maintained watertight for three to five (3-5) years, or sealed and maintained watertight for five (5) or more years.

542.03.17 Subsealing (Concrete Pavements).

Description	Method of filling the voids under the concrete pavement slab. Material such as cement grout or bituminous material is placed under pressure through holes drilled in the slab. Refer to SSP 421 regarding use of cement grout and SSP 426 for repair of pavement spalls.
Purpose	Inhibits pumping and migration of fine grained materials and water beneath the slab through joints and cracks that can lead to erosion of granular and stabilized subbases. Also, inhibits faulting.
Treatment Timing	Early detection of voids under the concrete pavement is critical since traffic induced stresses in an unsupported slab are much greater than allowed for in pavement design.
Existing Pavement Condition	Slabs in good condition exhibiting deflections of 1/4 to 3/4 inch.
Surface Preparation	Clean the surface. Pre-wet and wash holes as necessary to obtain a thorough distribution of the injected material.
Construction Limitations	Requires considerable expertise (specialty contractors) and unique equipment. Ineffective when used alone -- use with load transfer restoration and diamond grinding.
Existing/Projected Traffic	Use on all concrete pavements.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize danger to the work crew. The length of time generally depends on ambient conditions, subsurface conditions, and the time required for subsealant material to gain sufficient set prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	May extend the life of the pavement by ten (10) years when used in conjunction with diamond grinding and/or retrofit of dowel bars.

542.03.18 Retrofit of Dowel Bars (Concrete Pavements).

Description	Reestablishment of load transfer applied on one slab to an adjacent slab across joints and cracks by retrofitting steel or synthetic dowels. Generally, three dowel bars are retrofitted into each wheel path. Longitudinal cracks should be stitched with tie bars. Refer to SSP 426 for repairing pavement spalls.
Purpose	Reduce faulting, pumping, corner breaks, and spalling of the existing pavement.
Treatment Timing	May be appropriate for any concrete pavement that does not currently include load transfer devices. Use ground-penetrating radar to confirm the non-existence of dowel bars in the pavement.
Existing Pavement Condition	Slabs that include two or more (2+) full length or full width cracks should be replaced.
Surface Preparation	Clean the pavement surface. Clean slots for dowel placement with sand blasting followed by air blowing to produce a clean, dry, roughened surface free of loose particles. Slots should be slightly deeper than one half of the slab depth to permit the dowel being placed at mid-depth.
Construction Limitations	Limited effectiveness in addressing existing corner breaks. DO NOT install dowel bars where a longitudinal crack exists in the wheel path.
Existing/Projected Traffic	Use on all concrete pavements that do not contain existing dowel bars.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize danger to the work crew. The length of time generally depends on ambient conditions, and the time required for the grout to gain sufficient set prior to reopening to unrestricted traffic.
Anticipated Performance/Service Life	Estimated to extend the life of pavements by ten (10) years when used in conjunction with diamond grinding and/or subsealing.

542.03.19 Grinding Concrete Pavement.

Description	Method for improving concrete pavement surface smoothness.
Purpose	Eliminate joint faulting and/or restore proper surface drainage, riding characteristics, and skid resistance to the pavement surface.
Treatment Timing	Cracking or faulting affect ride characteristics.
Existing Pavement Condition	Distressed surface cracks and joint faulting make ride characteristics unacceptable.
Surface Preparation	Clean the pavement surface. Profilograph the roadway prior to grinding to identify “must grind” locations.
Construction Limitations	Limited short- and long-term effectiveness if not used in conjunction with other measures. Such as dowel bar retrofit or subsealing.
Existing/Projected Traffic	Use on all concrete pavements.
Traffic Control/Release	Restrict traffic and reduce speeds to minimize danger to the work crew.
Anticipated Performance/Service Life	Estimated to extend the life of pavements by ten (10) years when used in conjunction with retrofit of dowel bars and/or subsealing.